

# A Pulsed Nonlinear Raman Detection of Trace Organics with SERS Enhanced Sensitivity, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



## ABSTRACT

A significant technology gap for NASA astrobiology missions is the field detection of organics at the sub ppm level. Currently, NASA uses different sensing technologies such as Pyrolysis–GCMS to analyze planetary samples. These instruments require complex sample handling and can process only a limited number of samples. It is critical to develop an effective instrument with extended and enhanced capabilities to enable future planetary multiple-mission needs. We propose to develop a novel nonlinear Raman spectral sensing instrument for trace organic detection at the sub ppm level based on fluorescence-free surface enhanced Raman scattering (SERS). The proposed instrument will be capable of detecting the molecular signatures in Martian samples in the field with significantly improved sensitivity ( $>100,000,000$ ) and reduced noise ( $>100$ ). It will offer NASA a ultra sensitive deployable instrument suitable for robotic missions in terms of in situ measurements, resolution, bandwidth, compact size, low cost, and ruggedness. The detection of organics at the sub ppm level in Martian-like soils will be applicable to several future NASA missions, in particular future rovers for the upcoming Mars 2020 mission. These mobile, fast and agile rovers are focused on collection for sample return and require non-sampling analytical instruments.

## ANTICIPATED BENEFITS

### To NASA funded missions:

Potential NASA Commercial Applications: The successful development of the proposed ultra sensitive SERS sensor instrument will have extensive NASA's applications. The proposed system will create an opportunity to extend and enhance the capability of traditional NASA Earth and Planetary detection efforts in current platforms. It meets NASA's multiple-mission requirements for the best use of limited resources by reducing the risk, cost, size, weight as well as power consumption. It will also enable new measurements with greatly

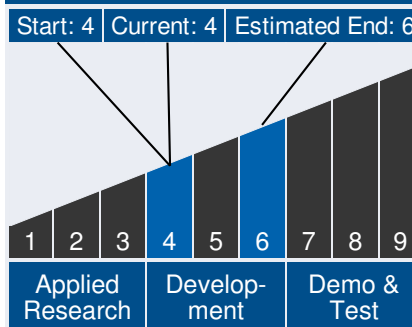


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## Technology Maturity



## Management Team

### Program Executives:

- Joseph Grant
- Laguduva Kubendran

### Program Manager:

- Carlos Torrez

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enhanced sensitivity for the planetary study. This technology will be useful for a broad range of in situ measurements for: space science and terrestrial geochemical, geophysical and geobiological studies; planetary protection applications.

## To the commercial space industry:

Potential Non-NASA Commercial Applications: Ultra sensitive spectral sensors have wide applications to include homeland security, life science, and matter physics and chemistry. It offers a fast, sensitive and accurate method of analysis suitable for both laboratory-based and plant based applications. In addition, a broad range of non-government commercial and industrial applications include environmental testing of water, soil and air; municipal and industrial water and waste-water quality testing; commercial product quality control testing of manufactured food, chemical, semiconductor, and other commercial products. Furthermore, laser spectral sensors have potential to provide the unique sensitive fluorescence-free and real-time analysis for biofuel production and oil exploration in energy industry.

## Management Team (cont.)

### Principal Investigator:

- Suning Tang

## Technology Areas

### Primary Technology Area:

Human Health, Life Support, and Habitation Systems (TA 6)

- └ Environmental Monitoring, Safety, and Emergency Response (TA 6.4)
  - └ Sensors: Air, Water, Microbial, and Acoustic (TA 6.4.1)
    - └ Major Constituents Sensor (TA 6.4.1.2)

### Secondary Technology Area:

Science Instruments, Observatories, and Sensor Systems (TA 8)

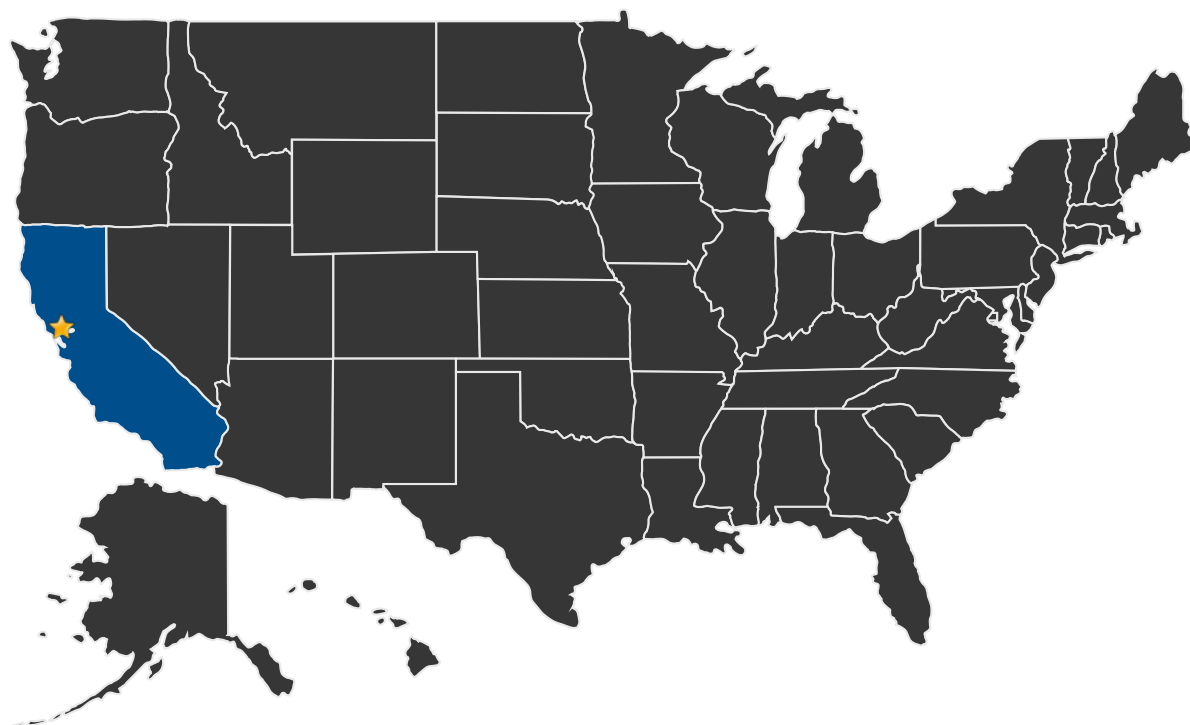
- └ Remote Sensing Instruments and Sensors (TA 8.1)
  - └ Lasers (TA 8.1.5)

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## U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work      ★ **Lead Center:**  
Ames Research Center

### Other Organizations Performing Work:

- Crystal Research, Inc. (Fremont, CA)

## PROJECT LIBRARY

### Presentations

- Briefing Chart
  - (<http://techport.nasa.gov:80/file/17802>)

Active Project (2015 - 2017)

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## DETAILS FOR TECHNOLOGY 1

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### Technology Title

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